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Application of Radioactive Elements to Biological Science

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The discovery of artificial radioactivity and the development of the cyclotron and atomic energy plant for the manufacture of artificially radioactive elements provided new valuable tools for biological research.

The principle of the use of isotopes in biological sciences is the preparation of labelled atoms of elements, which can be distinguished easily from the naturally occurring atoms of the same element. If such labelled atoms are in turn introduced in stable chemical positions, into molecules, these molecules or certain chemical groups in which they are combined, become labelled also, and then they can be traced in the body.

Radioactivity, both natural and artificial, is a property of the atomic nucleus and depends on the configuration of the nuclear particles. The best yields of different radioactive isotopes are secured to-day by putting various elements into an atomic energy reactor.

Most artificial radioactive nuclei emit β- and γ-rays. The β-rays may be either positively charged electrons—positrons; or negatively charged—negatrons. The γ-rays are electromagnetic waves of short wave length. Radioactive decay is measured by the half life of the element; for instance, for phosphorus (P^{32}) this is 14·3 days, for iron (Fe^{59}) 47 days, and for aluminium (Al^{29}) 6·7 minutes. Nitrogen (N^{16}) 8·4 seconds.

The unit used in measuring radioactivity is the curie. The curie is defined as the number of disintegration per second from 1 gr. of radium. The figure generally given for this is 3·7 by 10^{10}. The smallest amount of radioactive material is measured in millicuries or microcuries. The principal types of measuring instruments are the electroscope, the integrating electrometer and the Geiger-Müller counter. In the first two types named, the measurement is made in terms of the rate of movement of a pointer across a scale. In the Geiger-Müller counter, which is the most sensitive type of instrument, each single disintegration is converted into an electrical discharge.

The radioautograph technique has also certain applications in tracer studies. For this, the material is placed in contact with a photographic or X-ray film, and after a suitable exposure time the film is developed.

Hevesey (1923) was the first to use isotopes for biological research. He studied the uptake of radioactive lead by the roots, stalk and leaves of a plant *Vicia faba*.

Recently extensive metabolic studies have been made with the use of all radioactive elements as indicators.

Studies with radio-phosphorus have been the most widely used of all the artificially prepared radio-elements as a tracer for metabolic studies in biological systems. It has been observed (Chargaff & Keston (1940), Riley (1944)) that the retention of a single dose of disodium phosphate varied in different tissues in the following order: bone, muscle, liver, stomach and small intestines, blood, kidneys, heart, lungs and brain.

Interesting work has been done with radioactive iron. Iron is found in practically all tissues. Its most familiar function is as the central atom in ferriheme, which is the prosthetic group of the haemoglobin complex in mammalian erythrocytes and muscle tissue. In animals iron appears to be stored as ferritin, a protein containing ferric hydroxide. Ferritin is found especially in the liver, spleen, and bone marrow. Hahn and his collaborators (1939-43) have used radioactive iron in dogs to find the physiological aspects of iron absorption, mobilisation and excretion. The major finding has been that absorption of iron from the intestines of dogs is regulated by the dog's iron reserves. If these are high, little or no iron is absorbed. This situation contrasts with that of other mineral constituents such as phosphate in which a continual turnover between ingested and reservoir material is observed with the overall level being maintained by balance between absorption and excretion.

Moore *et al.* (1944) have shown that dogs and humans differed in efficiency of iron absorption depending on the valence form in which iron was administered. Dogs absorbed ferrous or ferric iron equally well, whereas human subjects absorbed ferrous iron more efficiently than ferric.

In normal animals it is found that haemoglobin iron of new red cells is derived from iron of old cells broken down by normal degradation rather than from reserve stores. The animal body is very efficient in utilising its iron.

Interesting investigations have also been carried out with the radioactive iodine isotopes I^{130}, I^{131}. Perlman, Morton & Chaikoff (1941) showed that circulating iodine rapidly appeared in the thyroid gland as organic iodine. More labelled organic iodine was present in the gland as diiodotyrosine than thyroxine. The appearance of these labelled fractions in plasma was noted as early as two hours after dosage.

It must be emphasised that tracer radiations in themselves constitute a hazard in research on metabolism, because marked physiological effects invalidating conclusions of tracer research can arise if high tracer concentrations are used. It is necessary to establish that such effects are not occurring in all tracer researches carried out using radioactive isotopes.

Recent attempts have also been made to use the radioactive isotopes in immunological and bacteriological investigations. Francis & Wormal (1948) made an interesting study with labelled protein which can be used as an antigen. As an antigen they used vitellin from the eggs containing radioactive phosphorus, which was injected into hens. The injection of radioactive phosphorus leads to the early appearance of the radio isotope in the various P containing compounds of the hen and its eggs. It was shown that the shell of the egg laid the day after the injection was highly radioactive, but that laid on the second day had only about half this activity; subsequently the radioactivity of the shells fell to a relatively low level. The white of the eggs showed very little radioactivity, particularly after the first day or two, but the P^{32} content of the yolk lipoids and the lipovitellin measured fairly rapidly up to a maximum at about four days after the injection and then decreased slowly. The eggs laid four to eleven days after the injection of radioactive phosphorus into the hen serve as sources of P^{32} containing vitellin and lecithin. The use of radioactive phosphorus will allow antigen antibody ratio to be determined in the precipitation test. Antibodies for this test were prepared by inoculating rabbits with ordinary vitellin and lecithin.

Libby & Madison (1947) have made interesting studies in the topographic distribution of a radioactive virus after intravenous injection into mice.

Radioactive tobacco mosaic virus was prepared by inoculating plants which had grown for 30 days in the radioactive nutrient solution. The tobacco mosaic virus was extracted from the stems and leaves and recrystallised three times. Evidence that the radioactivity was associated with the virus molecule was afforded by the fact that the specific radioactivity was constant during repeated crystallisations. Tests of the distribution of the tagged tobacco mosaic virus in the various animal tissues were made by radioautographs. The resulting photograph indicated a concentration of most of the radioactive tobacco mosaic virus in the liver. Only traces were found in the other tissues. The experiments also showed that the liver plays a major role in the removal, destruction and elimination of the virus. It is also suggested that the liver takes an important part in specific antibody production in virus diseases. Carbon dioxide incorporation reactions in bacterial metabolism have been studied with radioactive carbon by Barker & Elsden (1947).

The writer, with the collaboration of the Physics Department of the University of Liverpool, has studied the dissemination of tubercle bacilli containing radioactive elements in the body of experimental animals. The examples given have been selected to illustrate the uses of radioactive elements in various fields of biological researches. The development and use of this technique will solve many problems of the fundamental chemical processes of the body and will bring rapid and remarkable progress in biological studies.

(*References at foot of col.* 1, *page* 212)

Tick Control Measures

Assessment of the Value of Chemical Tickicides for *Boophilus (Margaropus) annulatus* var. *microplus* in Jamaica

By
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(*Continued from page* 201)

PART II: FIELD TRIALS

INTRODUCTION:

In the field, it is easy to estimate the general effect of any tick control agent on a herd of cattle but quantitative work is made difficult by two main factors:—

1. *The difficulty of assessing the degree of infestation.*—Even with short-haired cattle where even small nymphs can be seen clearly in the coat, counts are grossly misleading. The nearest approximation to a complete figure can be obtained only by stabling the animal for a period of two to three weeks and counting replete females as they drop off. Although this method gives the most valuable figure in that all potential breeding ticks are seen, males and immature forms (many of which die before engorgement) are missed and the method is obviously impracticable on a herd scale. Counts of adults or adults greater than a certain size on the animal have been attempted. Such counts are not of great value and general estimates were found more valuable and convenient in practice. The number of ticks actually harboured by animals classed as "lightly infested" is surprisingly high. Such animals, if stabled, may drop off as many as a thousand fully engorged female ticks during the course of two or three weeks.

A similar method of estimation may be used with respect to the whole herd, *i.e.*, a herd may be classed as "heavily infested," "lightly infested," etc. Such observations are of less value than the mean of individual estimates from all animals forming the herd. The susceptibility of individual cattle to ticks varies greatly, and it is usual for the infestations of one or two animals in a herd to be classed as "very heavy" while the remainder are classed as "free," or "very light." When reinfestation commences following dipping, a few animals are found to be heavily infected before the remainder of the herd is harbouring any ticks. That this infestation is an attribute of the individual animal rather than poor protection from ineffective dipping, is seen from individual records. The mechanism of this well known variation in susceptibility to ticks is unknown.

In dipping experiments some idea of the efficacy of the dip fluid and its persistence in the animal's coat can be gauged from the time it is possible to leave the herd before the presence of adult ticks again makes dipping necessary. As at this stage usually only one or two animals in the whole herd are carrying ticks to a noticable extent, the interval between dippings is the minimum and a longer practical working period between dipping would no doubt be possible if complete elimination of ticks was not the aim. Such information in itself gives a somewhat inaccurate picture of the actual efficacy of the dip fluid in question. It should always be supported by observations in the laboratory of ticks removed from dipped and undipped animals and by observations on the individuals of the herd. Rapid re-infestation of a few animals in the herd, while the bulk remains tick free, may result from inadequate deposition of the active agent on the coat. In this connection it is known that the first few animals to pass through the dip tank at dipping time do not get covered with the active agent as this has a tendency to sediment on standing, especially in the case of B.H.C.

2. *The impossibility of duplication of environment* makes comparison of the degree of infestation and of tick control methods in different herds not at all easy. The tick population varies from pasture to pasture, and from farm to farm. It varies with the climatic conditions and with the state of grass and pasture growth. Such factors make duplication of experimental conditions impossible. Many of these variables can be eliminated to some extent by treating groups of animals in the same herd, although here again practical difficulties are great, as few farms have more than one dip tank, and most cattle keepers are unwilling to allow too great an infestation to build up on their untreated cattle.

This still leaves the individual variation in susceptibility between animals which no amount of selection of matched groups can eliminate entirely. An attempt to overcome this variation between individuals by spraying half the body of the animal was not entirely successful.

Methods

In the present trials three methods of estimating tick population were used.

1. *Observations of individual animals*—either counting the number of ticks above a certain size on each animal (as in Mona, Grove Place and Barbican trials), or estimating the general level of infestation of individuals (as at Hope Farm, Knockpatrick and Mona cow herd).

This latter method proved of greatest practical value; infestations of individual animals were classified as "very heavy" (5 points), "heavy" (4 points), "moderate" (3 points), "light" (2 points), "very light" (1 point) or "free" (0 point). From this the average "tick index" per animal can be calculated by adding the total and dividing by the number of animals in the herd. Nymphal infestation was estimated in a similar manner in some cases.

TABLE I: DIPPING TRIALS REPORTED

No.	Property	Fluid under test	Method of application	Test animals	Duration of trial	Period between observations	
1	Hope	"Gammatox" 1 : 1,000	Dip	98 dairy cows	82 days	3–5 days	No control group
2	Wear Pen	" 1 : 500	"	A: 50 cows breeding B: 25 bulls C: 20 heifers & cows D: 22 calves	204 "	Usually 14 days	" groups
3	Knockpatrick	" 1 : 500	"	20 dairy cows	150 "	7 days	Two groups dipped alternately
4	Green Farm	"Wettable Agrocide" 1 : 250	Spray	36 cows & calves	400 "	—	No control group
5	Mona	DDT emulsion (0·25%)	Dip	60 dry cows	105 "	3 or 4 days	
6	Grove Place	" (0·5%)	Spray	10 dairy cows	96 "	2 days	
		Coopers cattle dip (0·22% As)	"	10 "			
7	Hope	"Gammatox" 1 : 500	"	9 calves			
		Government dip (0·20% As)	"	8 "	66 "	3 or 4 days	
		"Agrocide" powder	Dusting	7 "			
		No treatment	—	8 "			
8	Mona	"Gammatox" 1 : 250	Spray				
		DDT emulsion (0·5%)	"	3 cows and 3 calves in each group	30 "	3 or 4 days	One side of each animal used as control
		Chlordane (0·75%)	"				
		"Gammatox" plus DDT	"				
9	Barbican	DDT emulsion (0·5%)	"	10 dairy cows	96 "	2 days	
		Cooper's cattle dip (0·22% As)	"	10 "	96 "	2 "	

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By counting adult ticks of above 7 mm., some of the variations arising from personal estimations are eliminated, but the method is cumbersome and gives little additional information. In those trials where one side of the animal's body only was sprayed with tickicide, counting of ticks was essential.

2. *Observations on the herd.*—The general degree of infestation of the herd can to some extent be estimated by walking among the cattle in a pen or pasture. This method is of limited value and was used only in cases such as the Wear Pen herds, where detailed observations were not practicable.

3. *Interval between dipping.*—In the case of Green Farm records of the periods between spraying were kept; this gives only the times at which engorged ticks were beginning to appear and the

interval between dippings which is possible in practice.

An attempt was made to correlate weather conditions and the level of tick control. The difficulties of getting accurate weather reports and the inconclusive nature of the results render the data not worth recording.

(1) *Hope Farm.*—Dipping 98 head at two-weekly intervals in 1 : 1,000 Gammatox. No control group.

Good control obtained but not complete destruction. Kill greater after second dipping (due to cumulative effect of B.H.C. in coat) when a tick index fell from 1:40 to 0·62, 0·62, 0·84, 0·22. See Table II. The makers later recommended Gammatox to be used at a dilution of 1:500 in dipping tanks.

TABLE II: TICK INDEX OF CATTLE DIPPED IN 1 : 1,000 GAMMATOX

Date	May			June							
	22	27	30	5	10	13	16	19	23	26	30
Tick index	1·4 D	1·1	0·9	1·0 D	0·4	0·5	0·6	0·8 D	0·6	0·8	0·5

Date	July									Aug.		
	3	7	10	14	18	21	25	28	31	4	8	11
Tick index	0·6 D	0·3	0·3	0·5	0·6 D	0·1	0·3	0·7	0·8 D	0·2	0·1	0·2

D — Dipped.

(2) *Wear Pen.*—Four separate herds were observed. All were dipped in the same tank in 1 : 500 Gammatox. Dipping of any herd was done when engorged adult ticks were seen on the cattle in moderate numbers. In every case, only at this stage were a few animals from each herd harbouring ticks.

Replenishments of the tank were made at 1:500 strength, but 1:400 is now recommended.

SUMMARIZED OBSERVATIONS:

HERD A. 50 breeding cows.
- 29.9.47 DIPPED.
- 22.10.47 Mostly *free.* Few adult ticks present were viable, and laid viable eggs.
- 6.11.47 In "tick-free" pasture from 22.10.47. Two animals had a *light* infestation with nymphs.
- 14.11.47 Light infestation.
- 18.11.47 DIPPED. Light infestation. Index approximately 1·0.
- 17.12.47 DIPPED. Free except for *light* infestation of nymphs and adults on two animals.
- 24.12.47 Few animals *moderate* infestation adults. Tick index 1 : 2.
- 30.12.47 DIPPED.
- 12.1.48 Clean.
- 12.2.48 Very light infestation nymphs and adults.
- 19.2.48 DIPPED.
- 9.3.48 Very *light* infestation nymphs. No adults.
- 23.3.48 Medium infestation nymphs. Light infestation adults.
- 31.3.48 DIPPED.
- 6.4.48 Clean except for one or two with live nymphs.
- 22.4.48 *Medium* infestation nymphs in half herd. *No* adults.

HERD B. 23 resting bulls and steers.
- 22.10.47 DIPPED.
- 14.11.47 Very light infestation nymphs.
- 18.11.47 Moderate infestation nymphs and adults. Index approximately 2·0.
- 17.12.47 DIPPED. Mostly clean but a few with moderate infestation nymphs and adults.
- 23.12.47 DIPPED. *Heavy* infestation nymphs and adults.
- 12.1.48 Several *very heavily* infested all stages. Probably due to poor immersion through jumping dip.
- 14.1.48 DIPPED.
- 17.2.48 DIPPED.
- 23.3.48 *Clean* with few animals very *light* infestation nymphs.
- 6.4.48 Clean.
- 22.4.48 *Light* infestation nymphs.

HERD C. 20 cows, 1 bull.
- 30.9.47 DIPPED.
- 22.10.47 Two or three cows with *light* infestation nymphs and young adults.
- 14.11.47 *Heavy* infestation all stages. DIPPED.
- 18.11.47 Few cows with *light* infestation nymphs.
- 17.12.47 All clean.
- 24.12.47 *Medium* infestation nymphs, *light* infestation adults.
- 26.12.47 DIPPED.
- 12.1.48 *Heavy* infestation nymphs, light infestation adults.
- 20.1.48 *Heavy* infestation nymphs, *heavy* infestation adults.
- 22.1.48 DIPPED.
- 12.2.48 Heavy infestation nymphs, heavy infestation adults.
- 25.2.48 DIPPED.
- 9.3.48 *Very light nymph* and *light* infestation adults.
- 23.3.48 *Medium* infestation nymphs and adults, following 15 days in heavily infested pasture.
- 24.3.48 DIPPED.
- 6.4.48 Two or three cows had *very light* infestation nymphs and young adults. Mostly *clean.*
- 22.4.48 *Heavy* infestation nymphs. *No* adults seen.
- 24.4.48 DIPPED.

HERD D. 22 cows with calves.
- 7.11.47 DIPPED.
- 18.11.47 A few with *light* infestation nymphs and young adults.
- 17.12.47 A few with *light* infestation nymphs and young adults.
- 25.12.47 DIPPED.
- 12.1.48 *Light* infestation nymphs *medium-heavy* infestation adults, in a few animals. Most were *clean*—light.
- 26.1.48 Light infestation nymphs. *Heavy* infestation adults.
- 29.1.48 DIPPED.
- 12.2.48 Very light infestation all stages, except one cow not dipped 29.1.48.
- 16.2.48 DIPPED.
- 9.3.48 *Heavy* infestation nymphs. *Light* infestation adults after 21 days on badly infested pasture.
- 11.3.48 DIPPED.
- 23.3.48 *Very light* infestation nymphs. Very light adults—many dead ticks.
- 6.4.48 Six animals *very heavy* infestation nymphs. Light infestation adults. Remainder *very light.*
- 7.4.48 DIPPED.
- 22.4.48 *Moderate* infestation nymphs. *Clean*—adults.

These observations give a good idea of the times which could be allowed to elapse between dippings under practical conditions using B.H.C. dips when complete eradication of ticks is not the aim. The cattle were run in both lightly and heavily infested pastures and this is reflected in the intervals between dippings, *viz.*,

Herd A.—21 days, 28 days, 41 days, 51 days, 41 days.

Herd B.—27 days, 34 days, 22 days, 34 days, 64 days.

Herd C.—45 days, 40 days, 27 days, 34 days, 28 days, 31 days.

Herd D.—48 days, 35 days, 18 days, 23 days, 27 days.

It will be seen that dipping at three-weekly intervals will give adequate control even under adverse conditions and that under ordinary circumstances four or five week interval is permissible unless complete eradication of ticks is intended. Complete eradication could be accomplished by dipping at 14-day intervals with this strength of dip.

(3) *Knockpatrick.*—Gammatox 1 : 500 as a dip. This experiment was similar to those run at Wear Pen but the groups of cattle were smaller and observations more detailed. The milking herd was divided into two groups of ten cattle each, selected according to their degree of infestation before dipping; the groups were dipped in rotation when the degree of infestation warranted.

Each animal was classified at each two weekly inspection and a tick index for the groups worked out on this basis. Nymphal infestation was also recorded.

TABLE III: TICK INDEX OF CATTLE IN EACH GROUP: KNOCKPATRICK TRIALS

Date		November				December					January			
		6	7	17	25	2	9	17	24	31	6	13	20	27
Group I	Adults	2·2 D	0·4	0·4	0·0	—	1·0	2·0 Dx	1·9 D	1·6	2·3	2·0	3·4 D	1·4
	Nymphs	2·2	0·8	0·3	0·0	—	0·4	1·4	3·3	0·5	0·6	0·0	1·5	2·3
Group II	Adults	2·0	—	1·8	2·5	—	2·1	2·3 Dx	1·0 D	0·2	2·1	2·7	3·6 D	2·6
	Nymphs	2·4	—	2·0	2·7	—	2·2	1·7	1·8	0·1	0·0	0·0	2·0	2·4

Date		February				March					April		
		3	10	17	24	2	9	16	23	30	6	13	20
Group I	Adults ..	0·5	0·5	2·4	1·8	—	0·4	—	1·7	—	2·4	—	1·1
	Nymphs ..	1·0	0·1	2·9	2·0	—	1·0	—	1·1	—	1·4	—	0·9
Group II	Adults ..	1·3 D	1·6	1·4 D	1·0	—	0·4	—	1·0	—	2·2	—	1·7
	Nymphs ..	1·4	0·3	1·9	0·7	—	0·9	—	0·8	—	1·3	—	2·6

Dx — Dipped at 1/3 under strength. D — Dipped.

The effect of the dip is to prevent the development of the larval tick to the nymph stage. This is well brought out by the dippings on December 24th, 1947, and by the dipping of group II on February 3rd, 1948, and February 17th, 1948. In no case did the adult tick count fall appreciably—due to the continued development of young nymphs present at the time of dipping. The index for nymphs, however, falls greatly for the next three or more weeks, indicating that development of newly acquired larvae to this stage has been interrupted.

The tick infestation at no time became severe and a good control was maintained throughout. The property was moderately heavily infested with ticks as can be seen from the group II figures before the first dipping. Intervals between dipping were:—

Group I.—42 days, (7 days), 27 days.

Group II.—(7 days), 27 days, 14 days, 21 days.

(4) *Green Farm.*—Herd of 36 dairy cows and heifers. This trial was privately organised and no detailed records of tick infestations have been kept. The dates at which re-spraying was found necessary, are included in the report as it was felt that this information would be of value, the trial having extended over a 13-month period.

The standard of supervision and husbandry was high and spraying of the cattle was done whenever a few partly engorged adults were seen. Spraying was thoroughly performed using high pressure. During the period the animals were virtually tick-free.

The dates of the intervals between spraying are set out below. They indicate the general similarity of "Wettable Agrocide" to other B.H.C. tick washes and show the ease of controlling ticks in a small dairy herd where the level of infestation is low.

TABLE IV: DATES AND INTERVALS BETWEEN SPRAYING USING WETTABLE AGROCIDE

Date of spraying	Interval (days)	Remarks
17.3.47	—	—
23.3.47	7	"Cumulation" in animal's coat
3.4.47	11	—
14.4.47	11	—
5.5.47	21	—
7.7.47	65	Low tick incidence at this time of year
14.10.47	99	—
12.11.47	29	—
Two weekly sprayings	14	High tick incidence during winter months

(5) *Mona.*—Herd of approximately 50 dry cows and heifers, divided into two groups and dipped alternately, as required, in 1:59 DDT dip (0·25 per cent. DDT). Tank (capacity 2,300 gallons) charged January 5th, 1948. The cattle had not been dipped at all during the previous 12 months and there was a very heavy infestation on the pastures. Conditions were thus severe.

TABLE V: TICK INDEX OF CATTLE DIPPED IN 0·25% DDT EMULSION

1948	January								February						
	5	8	10	13	16	19	24	27	2	6	12	16	20	23	27
Group I 23 cows	3·2	3·4	3·5	4·4	4·4	3·8	3·9	3·8	3·5	3·7	3·6 D	1·6	0·2	0·1	0·1
Group II 35 cows	2·6 D	0·4	0·0	0·0	0·0	0·0	0·0	0·0	0·0 (Nymphs)	0·0	0·3	2·8	3·2	3·1	3·2

1948	March						April					
	1	8	12	20	23	30	2	6	9	13	16	20
Group I 23 cows	1·5	2·4	2·6	2·8	— D	0·6	1·1	1·0	1·1	1·0	1·1	1·4
Group II 35 cows	3·3	4·6 D	—	1·4	0·9	1·1	1·8	1·6	1·6	1·7	1·7	1·6

D — Dipped.

The initial dipping of group II caused a spectacular fall in the tick index and virtual freedom from ticks for 23 days, following which nymphs again began to appear. DDT appears to exercise a greater lethal action than B.H.C. on nymphal and young adult forms of the tick, since the development of nymphs to adults was absolutely stopped by dipping.

Subsequent dippings had a less spectacular effect on tick infestation although a very good control was maintained. Whether this decrease in efficacy is apparent or real, or whether or not it is due to falling off in the potency of the DDT in the dip tank it is not possible to say until the tank has been filled for a longer period. Estimation of active DDT in the tank is not at present practicable under field conditions.

Intervals between dipping of 42 and 20 days are recorded; these gave adequate but not absolute control of ticks.

(6) *Grove Place.*—Comparison of 0·5 per cent. DDT emulsion and Cooper's Cattle Dip both used as sprays.

Two groups of ten each milking cows selected for equal tick susceptibility were used. One group was sprayed every ten days with Cooper's Cattle Dip, the other as often as was needed with DDT emulsion.

Counts were made of all ticks larger than 7 mm. on a specified area of the escutcheon. The totals of all ticks so counted are converted to the index for comparison with the trials already reported. Infestation was not heavy.

TABLE VI: TICK INDEX OF DAIRY COWS SPRAYED WITH COOPER'S DIP AND 0·5% DDT EMULSION

Date	August		September										
	28	30	1	3	5	7	9	11	13	15	17	19	21
Cooper's dip	0·8 S	0·5	0·4	0·4	0·5	0·7	0·5 S	0·4	0·3	0·5	0·9 S	1·6	1·3
DDT dip	1·2 S	0·9	0·2	0·1	0·2	1·1	0·5 S	0·1	0·1	0·2	0·3	0·4	0·3

Date	September—*contd.*				October							
	23	25	27	29	1	3	5	7	9	11	13	15
Cooper's dip	1·8	0·9	0·8 S	0·7	0·8	1·4	1·4	0·8 S	0·6	0·6	0·7	0·5
DDT dip	0·2	0·1	0·1	0·1	0·0	0·0	0·0	0·8	1·2	0·6	0·2	0·1

Date	October—*contd.*								November			
	17	19	21	23	25	27	29	31	2	4	6	8
Cooper's dip	0·2 S	0·2	0·3	0·5	0·7	0·5 S	0·5	0·6	0·5	0·7	0·2	0·3
DDT dip	0·0	0·1	0·1	0·4	1·0	1·7 S	2·0	0·4	0·0	0·2	0·3	0·5

Date	November—*contd.*										Dec.	
	10	12	14	16	18	20	22	24	26	28	30	2	5
Cooper's dip	0·8 S	0·6	0·5	0·6	1·0	0·9 S	1·2	1·6	1·7	1·4	0·6 S	0·4	—
DDT dip	0·5	0·3	0·1	0·1	0·1	0·5	1·0	2·9 S	2·5	0·3	0·0	0·2	—

S — Sprayed.

Absolute control was never obtained by DDT spraying but the tick index fell and was maintained at a very low level, giving a practical control for periods of 50 and 28 days. Examination of counts from individual animals shows that it is the same individuals that tend to acquire ticks after each spraying. The failure of the spray to protect them cannot be blamed on inefficient spraying of the animal, as this is unlikely to have happened to the same animals on every occasion, but rather must be ascribed to the unexplained ability of certain animals to pick up ticks under circumstances where other animals remain free.

(7) *Hope Farm.*—Comparison of Gammatox 1:500 and arsenic-paranaph as sprays and Agrocide (4 per cent. B.H.C. powder) as a dusting powder against untreated control animals.

The groups were small and not well matched at the beginning of the experiment. The results are of interest, however, as they show the degree of control which can be expected by spraying at two-weekly intervals, and give a direct comparison with arsenical sprays.

Spraying was done with a small hand sprayer and penetration and thorough wetting of the coat was probably not always achieved.

TABLE VII: "TICK INDEX" OF CALVES SPRAYED WITH GAMMATOX, ARSENIC-PARANAPH AND DUSTED WITH AGROCIDE POWDER COMPARED WITH UNTREATED CALVES

	Number of calves in group	June								July	
		6	9	13	17	20	23	26	30	4	7
Gammatox 1:500	9	0·7 S	0·0	0·2	0·6	0·8 S	0·2	0·3	0·6	0·8 S	0·4
Arsenic-Paranaph	8	1·4 S	0·3	0·3	0·3	1·1 S	0·9	1·1	0·9	1·3 S	0·9
Agrocide powder	7	1·9 S	0·0	0·6	0·6	1·1 S	0·7	1·0	1·4	1·9 S	0·3
No treatment ..	8	1·5	0·6	0·6	0·8	1·1	0·8	0·8	1·3	1·5	1·5

	Number of calves in group	July—*contd.*							August		
		10	14	18	21	25	28	31	4	8	11
Gammatox 1:500	9	0·7	1·0	1·2 S	0·0	0·1	0·1	0·0 S	0·1	0·3	0·7

	Number of calves in group	July—*contd.*							August		
		10	14	18	21	25	28	31	4	8	11
Arsenic-Paranaph	8	1·0	1·1	1·4	0·5 S	0·5	0·3	0·0	0·6 S	0·9	1·0
Agrocide powder	7	0·7	1·4	1·1	0·0 S	0·0	0·1	0·0	0·0 S	0·4	0·9
No treatment ..	8	1·5	1·4	1·3	1·3	0·8	0·8	0·6	1·4	1·9	2·0

S— Sprayed.

The most efficient control was obtained with Agrocide powder. This was applied liberally and uneconomically. There is no reason to believe that equally good results could not be obtained with Gammatox suspension (1:500 or 1:250) and the results with the Gammatox spray are probably only inferior because application of the spray was not entirely efficient and the active principle not left adhering to the hair in sufficient quantity.

Arsenic-paranaph spray shows up very well in the test. It is almost as efficient as B.H.C. but its efficiency, as with all sprays, depends on the thoroughness of the spraying process. It has no residual action.

As with so many experiments of this nature, the tick count from untreated animals fell when they were run with animals treated with B.H.C. dips. There is probably enough transferred by animals rubbing together to cause death of some ticks on the untreated group.

Even with spraying at two-weekly intervals with Gammatox complete elimination of ticks was not achieved. This is partly due to the inefficiency of low-pressure spraying outfits. Spraying with wettable Agrocide (Trial 4—Green Farm) appeared to give greater control, but here standards of estimating ticks were less severe: high pressure spraying was used and infestation of pastures was far less.

(8) *Mona Spraying Trials.*—In this group of trials, three animals were used in each group. One side of the body *only* was sprayed in each case, with the object of leaving the other side as an untreated control. Estimation of tick infestation was by direct counts of all ticks over 7 mm.

Conditions on this property were severe. The animals were in poor condition and pastures heavily infested with ticks. Heavy rains occurred at various times during the course of the trial and all factors were in favour of heavy infestation.

Groups of three cows and three calves were sprayed with (1) Gammatox 1:250, (2) DDT emulsion (0·50 per cent. DDT), (3) Chlordane (0·75 per cent. Chlorodan) and (4) Gammatox 1:500 plus DDT 0·25 per cent. In addition one group of three cows was sprayed with (5) Chlordane (0·75 per cent. Chlorodan) plus DDT emulsion (0·25 per cent. DDT).

The sprayings were done with a small hand stirrup pump under field conditions. Such pumps as usually operated do not give a jet of sufficient intensity to wet the hair of the coat and it cannot be assumed that spraying was really efficient, although it represents the standard likely to be achieved ordinarily by the farmer.

Table VIII: Totals of Ticks Greater than 7 mm. on Left and Right Sides of Body
Three calves in each group

	Date	Totals of tick counts for three calves											
		October			November								Dec.
		23	28	30	1	4	7	11	14	17	22	25	2
Gammatox 1:250	Left	18 S	107	89	54	15	12	27 S	0	0	50	0	Many nymphs in all groups
	Right	45	233	161	176	87	85	112 S	2	0	46	0	
DDT 0·50%	Left	109 S	188	265	289	98	160	160 S	62	33	175	121	
	Right	189	690	580	672	562	648	687 S	98	66	176	131	
Chlordane 0·75%	Left	40 S	8	20	18	11	28	7 S	0	0	4	0	
	Right	113	270	334	349	138	207	200 S	10	15	27	0	
Gammatox plus DDT	Left	16	68	151	133	43	63	55 S	5	0	50	0	
	Right	52	328	393	283	167	176	131 S	2	0	54	0	

S— Sprayed 21.10.47 left side body only. SS— Sprayed 12.11.47 both sides of body.

Table IX: Totals of Ticks Greater than 7 mm. on Left and Right Sides of Body
Three cows in each group

	Date	Totals of tick counts for three cows										
		November							December			
		7	10	13	17	22	25	28	2	8	11	16
Gammatox 1:250	Left	952	591	278	215	175	170	391	253	299 S	14	5
	Right	924 S	61	3	58	50	37	80	237	211 S	5	4
DDT 0·50%	Left	724	429	282	280	316	310	308	319	344 S	14	3
	Right	878 S	81	3	78	67	64	98	164	300 S	14	5
Chlordane 0·75%	Left	596	966	414	284	219	201	177	135	252 S	20	2
	Right	669 S	130	0	13	11	22	20	38	137 S	15	0
Gammatox plus DDT	Left	1,302	1,113	392	327	371	382	439	324	445 S	59	92
	Right	1,309 S	105	34	73	32	69	90	202	400 S	53	62
Chlordane plus DDT	Left	711	788	400	313	181	225	234	236	244 S	30	7
	Right	712 S	69	12	40	22	21	67	142	219 S	30	4

Of the spray solutions tested, those containing B.H.C., Chlordane and B.H.C. plus DDT stand out as most effective. DDT dip was noticeably ineffective although it has been efficient in other trials. From examination of the counts for individual animals it is seen that this was not due to particular animals in the DDT group which were poorly sprayed, as all animals in that group carried a similar infestation. It is possible that thorough mixing of the emulsion was not made before removing the small quantity needed for preparing the spray, but this is unlikely, and the poor control is probably due to washing of the DDT emulsion out of the coat by heavy rains.

The apparent accumulative effect of B.H.C. and Chlordane in the coat is well shown in both cows and calves. After the second spraying (31 days apart) there was a greatly enhanced effect. This corresponds to experience obtained with dipping in Gammatox dips (Wear Pen trials).

The reduction of the tick population on one side of the body when the opposite side only is sprayed is of interest. This appears to indicate that there is some considerable migration of immature ticks, probably larvae, across the midline.

This group of trials shows that under adverse conditions B.H.C. and Chlordane sprays give a good control of ticks—more so than arsenical solutions—but that under conditions so favourable to ticks reinfestation occurs rapidly, even after the second spraying; reinfestation with nymphs was heavy after 32 days.

(9) *Barbican.*—Comparison of DDT emulsion (0·5 per cent. DDT) and Cooper's Cattle Dip used as sprays.

Two groups of five each milking cows were used. Observations were at seven-day intervals. The spraying was done with the usual small type of hand pump. For the first spraying only the right side of the animal was sprayed but on subsequent occasions both sides were treated.

Ticks were counted, the figures given in the table being total counts for all five animals in each group, left and right sides of the body being recorded separately. Conditions were poor and the tick population heavy.

After the second spraying DDT shows itself superior as a tick control agent. Except for a few days following spraying on February 2nd, 1948, complete eradication of ticks was not achieved although after spraying on January 22nd, 1948, the infestation was reduced to approximately two ticks per cow. Perseverance and more thorough spraying would give better results.

That conditions were severe and that spraying as it is normally performed is ineffective is shown by the counts of the animals sprayed with Cooper's dip.

TABLE X: TOTALS OF TICKS ON RIGHT AND LEFT SIDES OF COWS
Totals for five cows

		Totals of tick counts for five cows											
Date		December				January					February		
		1	9	17	23	2	8	14	22	28	7	12	18
Cooper's cattle dip	Left	215	306	382	398	563 S	56	66	1,308 S	15	—	185	124
	Right	190 S	83	84	180	358 S	66	94	1,316 S	16	—	177	137
0.50% DDT emulsion	Left	213	364	748	619	713 S	0	168	703 S	12	—	55	87
	Right	221 S	37	95	150	538 S	0	145	742 S	11	—	42	90

S.—Sprayed 1.12.47 right side of body only.
SS.—Sprayed 2.1.48 both sides of body.
SS.—Sprayed 22.1.48 both sides of body.

Conclusions

The great variation encountered under field conditions between infestations in individual animals and the apparently varying response to tickicides makes large scale experimentation essential. As more trials were undertaken it became clear that with no dip fluid was it possible to lay down definite times for the persistence of the dip in the coat for the length of time attachment of larval ticks was prevented (period of residual action) or for the period between dipping in practice.

The principal properties of the dip fluids tested are as follows:—

B.H.C. dip.—This was given a more extended trial than the other dips. It proved to be more efficient than dips containing arsenic or DDT.

B.H.C. does not cause death of adult ticks. These drop off on to the pastures and those partly engorged lay viable ova. Following dipping some nymphs may remain attached to the animal and develop and it is not until these have engorged and dropped off that the animal becomes completely free. It is probably for this reason that the second dipping appears to have a far greater effect as by it adults are then usually eliminated. It is doubtful if this enhanced action is due to accumulation of B.H.C. in the coat. That present since the first dipping has prevented further attachment of larvae.

As a dip, B.H.C. (1 : 500 Gammatox) gives good control with intervals between dippings of 18 to 51 days under fairly severe conditions. As a rule the residual effect of the B.H.C. in any form can be expected to last at least seven days. After this larvae may begin to attach and adult ticks will appear 10 to 14 days later. In using B.H.C. dips it is important to dip the animals as soon as young adults first appear. If dipping is delayed until these ticks are partly engorged, as can be safely done with arsenical dips, the adults drop off and will continue the life cycle.

B.H.C. (*as are all suspension-type dips*) is extremely liable to sediment to the bottom of the tank between dippings, and the first few animals dipped may not be fully exposed to an adequate concentration. The first 20 animals should always be re-dipped.

At 1:1,000 (half the strength now recommended) Gammatox gives control little if any better than arsenical dips.

As a spray "Gammatox" has proved very useful and probably offers the best method of tick control for the small scale dairyman. Its efficiency under these conditions is directly proportional to the thoroughness of mixing and spraying. Mechanical high pressure sprays are far more efficient.

Dusting with "Agrocide" powder is efficacious in controlling ticks but is expensive in material and labour. The powder is best applied with a dusting gun or else with a muslin bag filled with agrocide powder and patted over the coat. In either case it should be worked well into the coat. This method is most useful in dairies, where the animals will tolerate handling, and for milking cows and calves which it is undesirable to dip, and when, for some reason, spraying is not possible. Thorough spraying is as efficacious.

Promising results were obtained with mixtures of B.H.C. and DDT as sprays (*see below*).

DDT.—As a dip DDT was somewhat disappointing in view of the good results reported by Hitchcock & Mackerras (1947) in Australia. After the initial filling of the tank a good kill was obtained and a protective period of 42 days given before adult ticks were present in any numbers. Following this, however, dipping gave poor kills and disappointing residual effects. The reason for this is not clear and the trial needs carrying on for a longer period.

As a spray DDT gives fair tick control. The Grove Place trial shows that complete freedom from ticks cannot be expected even after spraying at 10-day intervals. When the period between spraying was extended it was only a few "tick-susceptible" animals on which ticks developed. However, very good control was given for periods of 10, 50 and 28 days. In direct comparisons with B.H.C. and Chlordane sprays DDT showed up badly, although it is superior to arsenic (Cooper's Dip) and has the advantage of a residual action.

It was when used mixed with equal parts of Gammatox dip (each at half the normal spray strength) that DDT showed greatest promise. Mixed with half strength Chlordane dip it also gave very good results. These combinations proved the best sprays so far tried. There is reason to believe from the mode of action of these dips that they would also give good results in dipping tanks. This it was not possible to check but it seems that the greatest drawback to mixing the dips in a vat would be that there is no means of analysis to determine the strength. This corresponds to the experience of Cobbett (1947) in Mexico.

There is no means of estimating the strength of DDT dips in the field.

Chlordane.—Unfortunately only small quantities of this dip were available for trial. These were used for spraying cattle in the Mona trials, but there was insufficient available to fill a tank at that time.

Results from field trials not reported in this paper, concerning which there were no observations by the author, appear to show that Chlordane dips give similar results to B.H.C., but that possibly the period of protection may be longer. Protective periods of 28 to 42 days have been reported under severe conditions using 1:500 dip.

In general, the action and efficiency appear similar to B.H.C. dips. Adult females drop off after spraying but survive and lay viable ova. There is an apparent cumulative effect in the coat as with B.H.C., giving far lower counts after the second spraying.

Chlordane is less volatile than B.H.C., and might be expected to have a greater residual effect. Without accurate comparison of figures from dipped cattle one cannot be sure of this, but it should be remembered that it has been shown by Hackman (1946) that with DDT most of the active agent is lost from the coat by licking within seven days, and that volatility probably does not greatly influence the length of period of the residual action.

There is no test available for the dip in the field.

Arsenical Dips.—These differ from the above three types of dip in that they have no residual effect on the coat. Their action is direct on the tick in all stages, causing death, and sooner or later, falling off. Fully engorged ticks may not be killed by arsenical dips but the eggs they lay are rarely, if ever, viable where dipping has been well carried out in every detail.

As *Boophilus annulatus* can complete development from larvae ("grass lice") to adult in 14 days, it is necessary to dip at at least this interval in order to ensure that every tick is dipped before it has the chance to complete engorgement and drop off to lay eggs. There are indications both from observations on stabled animals and from the field that the engorgement may in some circumstances be completed in 10 to 12 days, under Jamaican conditions. If this is so it points to the need to dip at 10-day intervals in arsenic solutions.

The greatest advantages of arsenical dips are the low cost and the ease of testing their strength. These two factors alone will ensure that for the present, at any rate, arsenical dips will remain the most useful means of tick control for most beef herds and for other cattle which can be easily dipped.

Other Species of Ticks

Dips containing B.H.C., DDT and Chlordane are effective in killing *Amblyomma cajanense* (the silver tick) and *Rhipicephalus sanguineus* (the brown dog tick), but not *Dermacentor nitens* (the tropical horse tick) except in high concentrations by hand dressing.

Toxic Effects

With B.H.C., irritation of the eyes is sometimes noticed immediately following dipping; this was noticeable in a few beasts after their first dipping but appeared to cause no subsequent trouble nor any permanent ill effect.

Following upon dippings at weekly intervals some scurfiness was seen in animals dipped in Gammatox. In one or two animals, this developed into an area of hard-skin which cracked to give deep fissures. The condition resolved when longer dipping periods were instituted. The injury was probably caused by the suspending agent used. No harmful results of ingestion were seen. The use of DDT or Chlordane dips caused no harmful effects.

The toxic effects of arsenic are well known. In excessive strengths it causes dermatitis, which is often severe and extensive, with shedding of the superficial layers of the skin. This does not often occur at strengths less than 0·40 per cent. arsenious oxide. The ingestion of arsenical dips gives rise to systemic symptoms,

often ending fatally. The poisonous nature of arsenical dips is one very great drawback of their use.

STABILITY IN THE TANK

B.H.C. and DDT both show signs of losing their efficacy in the tank. It should be the practice to recharge the tanks originally filled with 1 : 500 Gammatox with Gammatox at 1 : 400 strength. It is not clear if this loss of potency is due to removal of the particles of B.H.C. adhering to the coat or to chemical decomposition. The dips settle rapidly in the tank and the first few animals dipped may not pick up enough of the active agent. No information as to the stability of Chlordane dips is available.

Arsenic dips appear to be stable under Jamaican conditions, and in the few samples tested no sensible amount of oxidation of arsenite to arsenate had occurred. The potency of all types of dip is interfered with by the presence of mud, dung and organic matter in the tank.

General Discussion

(*a*) *Policy.*—In considering means of tick control the ultimate aim of dipping must be borne in mind. It must be decided whether the object of dipping is to exterminate ticks completely, or merely to control them to the extent that they produce little or no harmful effect *per se*.

The benefits of total extermination of ticks cannot be overstressed. Mohler (1930) estimates that the cost of eradication of ticks from the U.S.A. will be repaid in one year by the improvement in health and general condition of the cattle, especially calves, and more important, the freedom from anaplasmosis (chronic and acute) and piroplasmosis, both of which are tick-borne.

If it is to be undertaken in Jamaica, an eradication programme must be island-wide and can only end when the last *Boophilus* tick is destroyed. As herds in various districts become tick free, the cattle, especially young stock which would have had no experience of ticks during their life-time, become increasingly susceptible to both tick-borne diseases. If at this stage ticks are re-introduced, an outbreak of tick fever on a herd scale, with high mortality, will result. This has been the unfortunate experience in the past of cattle owners who have achieved a level of tick control in advance of their neighbours.

The larger cattle owner is at present faced with a dilemma. For the general health of his cattle, it is in his interest to eradicate ticks, but unless this is also done by his less provident neighbours he is laying himself open to the danger of a herd-scale outbreak of tick fever.

Eradication of ticks is technically possible in Jamaica where no alternative hosts exist, and could be achieved quickly with the dips now available. Rigid policing, supervision and enforcement of existing regulations are needed. Government policy should aim at total eradication.

(*b*) *Dipping or Spraying.*—The results given by B.H.C., DDT and Chlordane dips used as sprays show that they are far superior to arsenical sprays, especially in herds where complete eradication is not the aim.

To be effective, spraying must penetrate the coat and deposit the active chemicals on the skin and at the depth of the hairs. For this purpose a mechanical high-pressure spray (100 lb. per square inch) delivering a fine spray is by far the most useful. Hand sprays give poor results in the manner in which they are usually handled.

The possibility of using spraying machines or chutes to take the place of dip tanks needs investigating again now that more efficient tickicides are available. Such a machine should be mobile and could be driven to pastures distant from dipping tanks as required.

It is for the small scale cattle keeper that sprays have their greatest value. They are also extremely useful for dairy herds which are accustomed to handling. The efficiency of spraying is as high as that of the labourer handling the spray, and this is its chief limitation in practice.

With spraying of cattle deterioration of the spray solution is avoided since each batch is made up shortly before spraying to serve that day's needs; in the case of the new dips for which no test exists this is a particularly valuable attribute. Squibb (1946) reports very good results with DDT plus Cube used as a spray.

Dipping gives better results than spraying in most cases as the penetration and wetting of the coat is more efficient and no area of the coat is passed by as may happen with spraying. Most dipping tanks in Jamaica are too short, the usual length of the water line being only 20 ft., as compared with 37 ft. in Rhodesia and up to 50 ft. in Kenya. This means that swimming—necessary to work the dip well into the coat—does not always take place.

The disadvantages of dips as opposed to sprays are:—

(1) their initial cost;

(2) their immobility, necessitating long drives of cattle and resulting in overheating, injuries, loss of grazing time, drop in milk yield in milking cattle, abortions, etc.;

(3) the difficulty of maintaining the strength of dip fluid. The strength of the dip is difficult to control even with arsenical dips as the deterioration of testing iodine and starch solution occurs very rapidly (two to three weeks) under tropical conditions. With the newer more complex dips there is no field test at present available and the cattle owner can only judge the strength of his dip fluid from the results he is obtaining—hardly a satisfactory method. This absence of a test constitutes a serious disadvantage of the new dip fluids.

In spite of the disadvantages of dip tanks, their use gives the most practical method at present available for tick control in beef cattle. In the case of dairy cattle and calves efficient spraying with one of the new agents will usually give equal results with less disturbance and distress to the animals.

(*c*) *Arsenic resistance of ticks.*—A number of herds where ticks were said to be developing resistance to arsenical dips were visited. In no case were ticks resistant to arsenic discovered (see Part I of this paper). The reasons for failure to control ticks were usually one or more of the following:—

(1) Dirty dipping tanks; some had been as long as ten years without cleansing and refilling the tank.

(2) Under-strength arsenic solutions. Usually where testing was done it was found that the starch solution had decomposed or the iodine solution had degenerated. Some cattle keepers do not test their dips.

(3) Inadequate wetting of the animal. With some short tanks unruly animals can jump almost the length of the tank.

(4) Irregular periods of dipping—usually at some period before the complaint was made—often due to lack of supervision. Irregular dipping allows numbers of ticks to build up on the pastures and this is reflected later in the numbers of ticks picked up.

(5) The use of ruinate or badly managed pastures as grazing lands. Good pasture management is of great importance.

(6) Overstocking, often in conjunction with (5). As a result animals are in poor condition and acquire ticks readily. Any fault in dipping gets every chance to build up a heavy infestation under these conditions.

(7) Failure to dip other potential hosts (horsekind, goats and dogs).

Arsenical dips have proved efficacious in tick eradication in other countries, and if applied with equal thoroughness there is no reason why they should not do so in Jamaica.

Summary

A series of field and laboratory trials of dips containing B.H.C., DDT and Chlordane are described and conclusions drawn.

It is considered that using the laboratory methods described an opinion can be formed as to the probable value of the substance under test as a practical tick control agent. Results with larval and adult forms of the tick must be taken into account.

The results show these substances to be superior to arsenical dips as tickicides. They are, however, more expensive, and suffer from the fact that there is no field test to estimate their strength.

The dips are considered separately in detail and their relative merits assessed and compared with arsenical dip fluids.

A brief general discussion on factors affecting tick control under Jamaican conditions concludes the paper.

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CLINICAL COMMUNICATION

A Complication Arising from Dishorning Cattle

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When adult cattle are dishorned the frontal sinuses are unavoidably exposed to the atmosphere and it must be well known that some of the animals develop infection in these sinuses soon after operation. Usually this infection is of short duration and needs but little attention—in simple cases the animal's head may be tipped over to allow the pus to drain out; sometimes more general treatment is required if the animal develops systemic symptoms. In long-standing cases it may be necessary to irrigate the frontal sinuses to soften and remove inspissated pus.

The following two cases, however, occurred in animals whose horn cores had healed over completely with bone and new horn months after operation, and they therefore give rise to some anxiety that once infection has established itself in the frontal sinuses it may remain there for an indefinite period and at some time give rise to rather severe symptoms of pain and discomfort.

CASE 1.

Subject.—Ayrshire X Cow, aged 12 years.

History and Symptoms.—The animal was dishorned in March, 1948, the operation being performed under cornual nerve block. After the horns were sawn off haemorrhage was arrested by means of a piece of gauze smeared with Stockholm tar and bandaged over the wound. The dressing was removed 24 hours later, and healing was uneventful. Some four months later (July, 1948), by which time the horn cores were completely sealed with new bone and horn, this cow was seen to be ill and showed dullness, rather severe drop in milk yield, inappetence, elevated temperature and a characteristic attitude of the head which was raised high in the air and tilted slightly over to the left side. Percussion over the frontal sinuses revealed a difference in resonance between the two sides, the affected side being dull. There was also swelling over the left eye, the upper lid of which tended to droop. These symptoms appeared to ease during the next two or three days but subsequently became so severe that it was felt advisable to open the left frontal sinus.

Operation.—The operation was done in the standing position with the cow's head fastened by two halters over a wooden bar. The site for the centre of the trephine was decided as follows[1]: One inch above a line joining the upper margins of the orbital cavities and midway between the left supra-orbital foramen and the midline. The site was clipped and cleansed, and local anaesthetic was injected in and around it. A circular piece of skin and its connective tissue was removed and the periosteum was scraped away. The underlying bone was removed with a one inch trephine and a partition was seen in the frontal sinus immediately below, which held up the free flow of pus. However, in two or three days, a copious discharge of pus found its way out, aided by daily irrigations using a Simplex infusion apparatus and a teat siphon. The wound was kept open and well irrigated until discharge had ceased, when it healed uneventfully. The cow showed a marked improvement immediately after the operation and continued without further trouble until quite recently (January, 1949) when for two days she showed similar signs of discomfort. The left side was again affected but the symptoms, which were less severe than previously, abated after two days without treatment.

CASE 2.

Subject.—Ayrshire Cow, aged eight years.

This animal was from the same herd as Case 1 and the original operation took place within a few weeks of that performed on the other animal, the same method being used.

Symptoms of dullness, lack of appetite, fall in milk yield, elevated temperature up to 104° F. and unusual attitudes of the head were noted early in September, 1948, six months after dishorning. Percussion produced dull sounds from the right frontal sinus. The condition improved markedly after two days but returned five days later.

Trephining was carried out using a site slightly higher than in Case 1 and a considerable volume of rather hard, evil smelling pus was discharged immediately. The cow commenced to eat and brighten up as soon as the operation was over. Irrigations were continued daily for a fortnight, after which there was no more discharge, and the operation wound healed.

This animal showed further symptoms of infection in the frontal sinus early in January, 1949. The same side was affected and shortly after symptoms commenced a pus discharge began to appear from the site of the old trephine wound. The same area was trephined again—the healing of the old wound had produced a considerable thickness of new bone. The discharge was less copious than previously but continued for a longer period, making it necessary at a later date to cut away granulation tissue under local anaesthesia to allow a further period for free passage of the discharge.

COMMENTS

The herd in which these two cases occurred contains about 60 adult cattle, all of which have been dishorned, using the saw and Stockholm tar bandages. In a similar herd of Ayrshires under the same manager and with similar general conditions there have been no such complications from dishorning. It is noteworthy that in this latter herd haemorrhage was arrested by the use of the hot iron, and no bandage was applied. In further herds which have been dishorned, bandages and Stockholm tar have been abandoned in favour of the hot iron and so far there have been no serious complications of the type described.

Considerable interest has been aroused lately over the method of dishorning cattle with elastic bands, and it does seem that should this method prove satisfactory for widespread use it would have the advantage of removing the horns without opening up the horn cores so that infections of the frontal sinuses would be avoided.

Reference.—(1) Dollar's Veterinary Surgery, Third Edition, page 250.

ABSTRACTS

[A New Treatment for Demodectic Mange. MOOREHEAD, C. A. (1948.) *N. Amer. Vet.* **29.** 649-650.]

A new treatment for demodectic mange is described, using an emulsion containing sulphur, rotenone, and sodium di-hydroxy diphenyl methane, with mineral oil, vegetable oil, and pine oil.

The emulsion is applied daily, or on alternate days, and rubbed into the lesions, using a stiff bristle brush. This treatment is continued as long as visible lesions persist. In those cases where extensive lesions are present, the emulsion is applied to one-third of the body area at one time. The author claims that recent infestations respond within a week to ten days, but chronic cases may require four to 12 weeks.

The article is based on the experience of 100 cases during the last two years, and six detailed case histories are included.

D. W. J.

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[Fasciolicidal Efficacy of Hexachloroethane-Bentonite Suspension in Goats. OLSEN, O. W. (1949.) *Amer J. vet. Res.* **10.** 71-73.]

Critical anthelmintic tests performed on nine goats which were killed after treatment showed that 70 per cent. of flukes (*Fasciola hepatica*) were removed by treatment with 30 c.c. of the standard hexachloroethane-bentonite suspension. The efficacy of the treatment was reduced for the group by one goat in which only 33 per cent. of the flukes were removed. Had this goat, which was very severely affected with marked thickening and fibrosis of the bile ducts, been omitted from the calculations the efficacy of the treatment would have been 93 per cent. Flukes in grossly abnormal sections of the liver generally survive treatment—possibly because destruction of the capillaries and canaliculi by connective tissue induration may prevent excretion of the drug from the blood into the bile where it comes into contact with and kills the flukes. Surviving flukes usually are found in enlarged and thickened bile ducts.

It is probable that a number of flukes killed by the treatment may have disintegrated completely and would not be found by faeces examination—anthelmintic activity would then be higher than estimated.

The goats tolerated 30 c.c. of the mixture composed of 500 grammes hexachloroethane, 50 grammes Bentonite and water to 1 litre. No further deaths followed treatment of a flock affected with clinical fasciolíasis and there was marked improvement of their physical condition.

J. S. S.

REVIEW

["**Our Plundered Planet.**" By Fairfield Osborn. Faber & Faber, 10s. 6d.]

To few engaged in attempting a public service is sufficient leisure vouchsafed to be able to appreciate or even study world conditions in an objective manner. This is perhaps especially true of the veterinary profession; we tend to be overcome by routine, to struggle with more or less success to fill a small but useful niche in society, without seeing the vital importance of our role in a hungry world. A useful corrective, an admirable presentation of the historical and actual position of man in relation to his environment, is to be found in "Our Plundered Planet" by Fairfield Osborn.

It is a staggering thought that each dawn sees 57,000 more mouths to be fed than at the previous dawn! This work traces the vast increase of population since the 17th century, making man what the author rightly calls "a major geologic force." His husbandry, his wars, his deforestation, have tended to cause soil erosion in various parts of the world on such a scale as, if it continues unchecked, to threaten the survival of mankind. Mr. Osborn's analysis of the present position, especially in the U.S.A., is not hopeful. His conclusion is that, in spite of much advance in our knowledge of methods of combating erosion, there is still not enough realisation, either in high places or among those whose exploitation of natural resources is threatened by conservation measures, to give much hope of achieving results.

This is "strong meat": the whole book is written in a cogent style, packed with fact, logical, and instinct with the urgency of the problem. It should be read and re-read by everyone concerned, in however small a way, with the utilisation of natural resources.

QUESTIONS IN PARLIAMENT

Veterinary College Lecturers (Pay)

Sir W. Darling (April 11th) asked the Secretary of State for Scotland why the scale of salaries for the lecturers of the Royal (Dick) Veterinary College, Edinburgh, is lower than the scale which obtains for lecturers of the Royal Veterinary College, London.

Mr. Woodburn: The scales of salaries for comparable lecturer grades at the two colleges are as follow:

	Royal (Dick) Veterinary College	Royal Veterinary College, London
Junior lecturers.	£485 × 25 × 825	£500 × 25 × 850
Senior lecturers.	£680 × 30 × 1,100	£800 × 25 × 1,000

Of the eight senior lecturers at the Royal (Dick) Veterinary College, four receive in addition a special "charge" allowance of £150 per annum.

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Cattle Transport

Lieut.-Colonel Sir Thomas Moore (Q.47) (April 11th) asked the Minister of Agriculture whether he will arrange that horned and dehorned or hornless cattle are not transported from farm to slaughterhouse in the same truck or van.

The Minister of Agriculture (Mr. Thomas Williams): The separation of horned and hornless cattle would not prevent the horned cattle injuring each other. I will, however, look into the matter and consider whether it is possible to secure the desired object in some other way.

Sir T. Moore: While thanking the right hon. Gentleman for that sympathetic reply, may I ask whether he will bear in mind that, apart altogether from the pain involved in these injuries, there is serious deterioration caused to stock?

Mr. Williams: The hon. Gentleman's suggestion would not prevent one horned animal injuring another horned animal even if the dehorned and hornless cattle were separately transported.

Sir T. Moore then asked the Minister of Agriculture whether he will make a regulation forbidding the transport of young calves to central slaughterhouses unless conditions in respect of food and space during the journey are satisfactory.

Mr. T. Williams: It is an offence under the Transit of Animals Orders of 1927 and 1931 to overcrowd any railway or road vehicle to such an extent as to cause injury or unnecessary suffering to the animals carried therein. It would hardly be practicable to make the feeding of young calves in transit a statutory obligation but I will consult with my right hon. Friend the Minister of Food as to whether it would be possible to place some limitation on the distance calves are sent from collecting centres to slaughterhouses.

Sir T. Moore followed by asking the Minister of Agriculture if he will introduce legislation making it imperative that cattle intended for slaughter shall have their horns treated by caustic to prevent their growth while still newly-born calves.

Mr. T. Williams: No, Sir. Although I agree that dis-horning diminishes the risk of injury to cattle when in yards or in transit, I do not consider it advisable to introduce legislation making dishorning compulsory.

Sir T. Moore: Does not the right hon. Gentleman realise that if he were to accept the suggestion in this Question, it would give him an answer to my suggestion in Question 47?

NOTES AND NEWS

Diary of Events

Apr. 23rd.—Association of State Veterinary Officers: Annual Meeting at the Royal Veterinary College, Camden Town, 2 p.m.; Annual Dinner at the Criterion Restaurant, Piccadilly, 6.30 p.m.

Apr. 27th.—Meeting of the Mid-West Division, N.V.M.A., at Bristol (Berkeley Café, Clifton), 2.15 p.m.

Apr. 27th.—Meeting of the East Midlands Division, N.V.M.A., at Sutton Bonington, 2.15 p.m.

Apr. 27th.—Meeting of the Southern Counties Division, N.V.M.A., at Southampton (Polygon Hotel), 6 p.m.

Apr. 28th.—Special Meeting of the Central Veterinary Society at the Royal Veterinary College, Camden Town, 2 p.m.

Apr. 28th.—Meeting of the South-Eastern Division, N.V.M.A., at Tunbridge Wells (Mount Ephraim Hotel), 2.30 p.m.

Apr. 29th.—Meeting of the Yorkshire Division, N.V.M.A., at York (Royal Station Hotel), 2.30 p.m.

Apr. 29th.—Extraordinary Meeting of the Midland Counties Division, N.V.M.A., at Birmingham (Grand Hotel), 2.30 p.m.

May 3rd.—R.C.V.S. Animal Management Examination tour, commencing with London.

May 4th.—Meeting of the North of Ireland Division, N.V.M.A., at Belfast (Queen's University), 7.15 p.m.

May 5th.—Annual Meeting of the Central Veterinary Society, at the Royal Veterinary College, N.W, 5.30 p.m.

May 16th.—R.C.V.S. Pharmacology, etc., Examination (Revised Syllabus). Written, 10 to 12 noon, at appropriate Colleges.

May 16th.—Annual Meeting of the R.A.V.C. Golfing Society, at North Hants Golf Club, Fleet, 10 a.m.

May 17th.—Spring Meeting of the Eastern Counties Division, N.V.M.A., at Colchester (Red Lion Hotel), 2.15 p.m.

June 1st (Wednesday).—Annual General Meeting of the Royal College of Veterinary Surgeons.

June 1st, 2nd and 3rd.—Quarterly Meetings of Council, R.C.V.S.

June 7th and 8th.—D.V.S.M. Written Examination, Royal (Dick) Veterinary College, Edinburgh.

June 23rd and 24th.—R.C.V.S. Membership Written Examination.

Aug. 8th to 13th.—Fourteenth International Veterinary Congress, Central Hall, Westminster, and Church House, Westminster, London, S.W.1.

Aug. 12th to 15th.—Sixty-seventh Annual General Meeting and Congress, N.V.M.A., in London.

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N.V.M.A. Grassland Conference Proceedings

With this issue of *The Veterinary Record* we distribute to members, N.V.M.A., the proceedings of the Association's Conference on Grassland and Animal Health held at the Headquarters of the Wellcome Foundation, Euston Road, N.W.1, on October 28th and 29th, 1948, with the President, Dr. R. F. Montgomerie, in the chair.

Copies are available to non-members at 6s. 6d. each (post free) and to veterinary students at 2s. 6d. each (post free) on application to the General Secretary at 36, Gordon Square, London, W.C.1, to whom any member failing to receive his copy also should apply.

CENTRAL LIBRARY FOR ANIMAL DISEASES

Resumption of Service

The war damage repairs to the main Reading Room now having been completed, the Library service has been resumed as before and books are again available without notice.

Accessions for Quarter Ending March, 1949

PRESENTATIONS

Books

HOARE, E. W.: Materia medica and therapeutics, 6th edition. (1942.) Presented by Professor G. F. Boddie.

Iodine facts, Vol. I. (1940-46.) Presented by the Iodine Educational Bureau.

Draft of an international list of animal diseases, compiled by the staff of the Onderstepoort Veterinary Research Institute. (1938.) Presented by the Director.

STAPLEDON, R. G., and DAVIES, W.: Ley farming. (1948.) Presented by Mr. Gould.

Reports, 12; *Pamphlets and Reprints*, 51

PURCHASES

AINSWORTH, G. C., & BISBY, G. R.: A dictionary of the fungi. 2nd edition. (London, 1945.) 20s.

BENBROOKE, E. A., & SLOSS, M. W.: Veterinary clinical parasitology. (Ames, 1948.) 26s. 6d.

BIESTER: Diseases of poultry. 2nd edition. (Ames, 1948.) 58s. 6d.

BURN, J. H.: Background of therapeutics. (1948.) 22s. 6d.

CORRIE, F. E.: Some elements of plants and animals. (London, 1948.) 8s. 6d.

DUKES, H. H.: Physiology of domestic animals. 6th edition. (New York, 1947.)

HALL, M., *ed.*: Five hundred varieties of herbage and fodder plants. (Aberystwyth, 1948.)

KELSER, R. A., & SHOENING, H.: Manual of veterinary bacteriology. 5th edition. (Baltimore, 1948.) 36s.

KIRK, H.: Index of treatment for the canine and feline surgeon. (London, 1947.) 40s.

MARTIN, C. R. A.: Practical food inspection. 2 vols. (London, 1947 and 1948.) 36s.

MONNIG, H. O.: Veterinary helminthology and entomology. 3rd edition. (Baltimore, 1939.) Reprint. 31s. 6d.

WILLIAMS, W. L.: Diseases of the genital organs of domestic animals. 3rd edition. (London, 1943, with 1947 addenda.) 54s.

WILLIAMS, W. L.: Veterinary obstetrics. 4th edition. (Massachusetts.) 40s.

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Removal from R.C.V.S. Register

At a special meeting of Council held on Wednesday, April 6th, 1949, the Council directed that the Registrar remove from the Register of Veterinary Surgeons the name of James Cox Brown, of 104, Harehills Lane, Leeds: he having been found guilty of conduct disgraceful in a professional respect.

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PERSONAL

Birth.—SCOTT.—On April 14th, 1949, to Vera, wife of Kenneth E. Scott, M.R.C.V.S., 10, Portway, Wantage—a son.

. . . . .

Mr. Richard Hughes, of Oswestry, at 93.—Our readers will join with us in congratulating Mr. Richard Hughes, F.R.C.V.S., of Bryn Oswallt, Queen's Road, Oswestry, on the celebration on March 30th last of his 93rd birthday. Although the name of this fine practitioner veteran does not appear in the honoured published list *Chirurgorum Veterinariorum Collegii Regii Seniores*, which numbers five members, his must head the remainder, as he qualified from Glasgow (with honours) in April 13th, 1880, securing his Fellowship in 1893. After graduation Mr. Hughes spent two years with R.C.V.S. Examiner, Mr. B. Cartledge, of Sheffield, and in 1882, knowing Oswestry district to be noted for breeding excellent farm animals, he resolved upon practice there, spending as he tells us "a busy and happy life" until, nearly 20 years ago, he retired in favour of his son—"except when clients want the old 'un!" Thus we are happy to know that Richard Hughes continues to enjoy the robust health that enables him, despite his wonderful toll of years, to continue to render in some measure that service in practice which has been equally his life's interest and delight.

DUNCAN'S HORSES

Royal Veterinary College Statement on the Adrian Jones' Group and Fund

In our issue of June 19th, 1937, we announced the establishment of an appeal fund to enable the profession to require the masterpiece "Duncan's Horses" for the Royal Veterinary College, the *alma mater* of the eminent sculptor, Captain Adrian Jones, M.V.O., M.R.C.V.S., one-time Veterinary Officer, 1st Life Guards. The group was shown in the Academy of 1892 and, having escaped largely unscathed from the disastrous fire at the Crystal Palace, was generously offered by Adrian Jones to the London School, subject to the defraying of certain costs. The sculptor's death in 1938 leant a poignant stimulus to a fund which had thus acquired a memorial significance. The late Major G. W. Dunkin, the primary sponsor of the appeal, which was made through our columns, had the satisfaction of publishing therein notification of generous response, when the war intervened to terminate this, as all other worthy projects not concerned with its prosecution.

In response to enquiries recently made, for the information of subscribers, we are authorised to publish the following statement:

"Before the war it was proposed to cast the group into bronze and erect it at the Royal Veterinary College, but the war stopped the scheme. The foundry to which the plaster group had been sent was closed and the group removed to the College at Camden Town.

"In 1947, at the request of Colonel Simpson (Treasurer of the Fund), the Governors of the College received from him the balance of the fund, amounting to £872 3s. 4d. Enquiries were made of a very eminent sculptor to ascertain the name of a firm competent to cast the plaster group into bronze and to erect it at the College. This firm estimated that the cost—at 1947 prices—would amount to some £4,000. This meant that it would be necessary to raise a further sum of more than £3,000, and the Governors felt that the right time had not yet come to launch an appeal for a sum of this size."

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POULTRY (STOCK IMPROVEMENT) ADVISORY COMMITTEE

At their meeting on April 7th, the Poultry (Stock Improvement) Advisory Committee considered the Regulations of the Accredited and Probationer Sections of the Poultry Stock Improvement Plan for the 1949-50 season commencing December 1st, 1949. The Committee recommended various amendments to the existing Regulations in the light of experience gained in the administration of the Plan during the past year, and of recommendations submitted by the representative organisations of the Poultry Industry and by County Agricultural Executive Committees. These recommendations have been accepted by the Ministry.

The Ministry has also accepted a recommendation of the Committee to suspend recruitment of new entrants into the Plan for a period of one year, *i.e.*, for the 1949-50 season. This recommendation was made by the Committee with extreme reluctance after full consideration of the over-riding difficulties caused by shortage of poultry technical staff for the proper supervision of the Plan in view of the greatly increased membership, and by the need to impose a limit to the volume of feedingstuffs issued to accredited breeders, which has risen substantially in the past two years.

The Committee considered proposals submitted to the Ministry by the National Farmers' Union for the operation of the Approved Section of the Plan under the supervision of the Poultry Industry. These proposals were referred for detailed examination to the Sub-Committee responsible for devising the Poultry Stock Improvement Plan. Mr. G. R. H. Nugent, J.P., was appointed Chairman of that Sub-Committee following the resignation of Mr. Percy Francis, O.B.E.

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B.C.G. Vaccine in the Control of Human Tuberculosis

There has been a natural reluctance on the part of the Health Authorities in this country to use a living organism, B.C.G., for the protection of human beings against tuberculosis. The tragedy of Lubeck at first raised serious doubts as to the harmlessness of B.C.G. but the searching enquiry into the cause of the death of the inoculated children showed clearly that, arising from the cultivation of B.C.G. and virulent strains in the same laboratory, cultures believed to be those of B.C.G. were, in fact, contaminated with pathogenic strains. It is now universally recognised that the attenuation of B.C.G. has reached a stage where reversion to a virulent variant will not arise and bearing in mind the lessons to be learned from the Lubeck disaster, it is unlikely that any uncalled-for reactions will arise from the vaccine. The chief

matter of concern at the moment is the possibility that, with continued artificial cultivation, the antigenic value of the strain, which already shows some signs of weakening, may become still further debased.

B.C.G. has been used on a wide scale in France, Denmark, Norway, Sweden and other parts of the world. In the Scandinavian countries there has been a substantial increase in the numbers of tuberculin-negative persons of the early adolescent group and this has been followed by a sharp rise in incidence of acute primary pulmonary tuberculosis which is often rapidly progressive. The present campaign in these countries aims at persuading the young adult to submit to a tuberculin test. Persons who are tuberculin-negative, especially those who are exposed to especial risk such as medical students, nurses, etc., are offered B.C.G. vaccine.

Tuberculosis officers in this country are concerned at the increase in tuberculosis in young adults and for some time have been urging the liberation of the vaccine for use in selected cases. The following note from the *Times* of March 31st describes the scheme which is being sponsored by the Ministry of Health.

"A national plan for testing a system of vaccination against tuberculosis among groups of people in various centres enlisted on a voluntary basis is being worked out by the Ministry of Health and the Scottish Department of Health.

"The system, known as Bacillus Calmette-Guérin vaccination, has been tried with success in France, Denmark, and America, and experts from this country have visited Denmark to study the technique of applying the system and to arrange for supplies of the vaccine to be made available. It is expected that a start will be made in about three months.

Details of a scheme for applying the system under proper medical supervision are now being worked out. Volunteers will first be sought in areas where the incidence of tuberculosis is high, of which Edinburgh will be one. The volunteers will be taken principally from nurses and medical students and young people in contact with tuberculosis cases in their homes. It is expected that the regional hospital boards will administer the scheme for nurses and students, but the assistance of local authorities will be required for establishing the necessary degree of supervision and control over volunteers vaccinated in their homes.

"It is intended that the trial shall be extensive and that some thousands of volunteers shall be sought for treatment. It will be some years before observations of the effect of the vaccine will enable conclusions to be drawn on its value in reducing the incidence of tuberculosis in this country."

The campaign will be carefully regulated by the Ministry of Health in conjunction with the Medical Research Council and, as can be seen from the above note, will be on a voluntary basis. Much of the Continental work has been severely criticised on the grounds that the advice of the statistician was not sought before the trials were commenced, and the interpretation placed on the results which seemed to support B.C.G. as a means of controlling the disease did not bear close inspection. Recent investigations, however, are not open to quite the same objection. In so far as this country is concerned it is desirable to move cautiously and endeavour to assess the value of the project under properly controlled conditions. The outcome of these trials will be watched with great interest.

Much work has been expended in this country on laboratory and field trials designed to test the efficacy of B.C.G. in protecting cattle against tuberculosis. In spite of certain drawbacks, vaccination can induce a fair measure of protection. Its use in areas where bovine tuberculosis in individual herds is still very high, offers a promising field for enquiry.

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THE MILK PROBLEM

"A Joint Committee of the B.M.A. and the National Veterinary Medical Association, with equal numbers on each side, is starting some useful work," observes the *British Medical Journal* in its issue of April 16th and continues: "It has decided to tackle first of all the subject of milk and milk products, including the health of the cow. When that job is done it will turn to meat and meat products (presumably if by that time meat has not vanished from the British table). The committee has already had some long discussion on milk in relation to child and family health, and at its second meeting the other day it considered a long memorandum on milk distribution in which the present marketing and retailing methods were reviewed, and the question of the cleanliness of milk and the prevention of contamination at the various stages of production and delivery was gone into very thoroughly. The committee is addressing itself to the question of ensuring efficient and cheap deliveries—by efficient delivery being meant a system whereby every domestic consumer will be able to obtain, within reasonable limits, the type of milk he desires, free from any risk of disease and capable of keeping for at least 24 hours after delivery to his home."

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THE FREEDOM OF SCIENCE

Danger of Trend Towards Political Control

In the course of a contribution, "Research and Politics," to the issue of *Science* of Friday, March 4th, 1949 (**109,** 219), Richard B. Goldschmidt observes: ". . . I do not want to imply that we are in danger of having a Lysenko appear in our midst. But there are different degrees of such things. This brings me back to the fourth recent development in science which I recounted in the introduction to this address, when I said that only small steps lead from organised team-work to professional planners and finally to political control. I cannot help saying that I have followed with serious misgivings the increasing trend towards planned and organised science, though realising its need in certain fields. Formerly, a scientist thought out or encountered a problem and started working on it. As often as not he found something in the course of the work which led him in a new direction. An occasional observation, which most others would have overlooked, led the born researcher into new fields, an unexpected flash of an idea opened new vistas and led to solutions or to more problems. All great ideas and all great discoveries in the realm of pure science have come into existence this way.

"But now a man does not work on some subject or problem. He has a 'project.' A plan has been laid out, even worked out in all detail, a staff has been brought together and each one has been assigned his duty. An organisation has approved the plan and furnished the funds; in return it expects progress reports, visible and quick results, and no deviation from the plan agreed upon. Everybody is happy to have a 'project,' and only Minerva covers her face and sends the owl away to catch mice.

"I realise, certainly, that there are types of work which should be handled as organised 'projects.' If you want to prepare 200 stereoisomers of some organic compound and test their action as insecticides, a project is in order. If you want to eradicate a certain mosquito in a certain place, go and organise it. But how a major discovery or idea can come from a project I am unable to understand. This, however, is not what I want to discuss. I want, rather, to point to the danger to the freedom of science which lurks behind this way of making science. The danger will come from the men who are attracted to such a type of scientific big business. The thinker, the blaster of new paths, the keen observer, the man of intuition whose thinking is ahead of his time, will not flock to the big Government-financed and -sponsored projects. Sooner or later leadership will fall to the university politician, the promoter, the men who make the headlines—headlines not in the history of discovery but in the Press. Second-raters will attain the power that goes with the big funds, and then the moment of danger arrives. They will favour what they like and understand, suppress what is beyond their vision. Being not too intelligent, they will fall prey to the flatterer, and will always go along with the latest scientific fashion or even the doubtful schemes of fanatics or reactionaries, and certainly always with well-entrenched schools. They will easily find the ear of the politicians who run the funds, for both talk the same language. At this point the setting is ready for a Lysenko type. Though our political system will not give him a chance to act as savagely as is possible in Russia, he could do enormous damage to the progress of science and the freedom of research if not checked in time. This sounds very pessimistic, but human nature is the same everywhere, fanatical activists are available everywhere if not kept in check, and men who believe in 'politics as usual' are not only more numerous than men of original ideas but are also more selfish and ruthless. Thus, I believe that the increasing financial support of research, especially by government and political agencies, tending to flow into the channels of organised research, is fraught with the danger of bossism in science, with the danger of subsidising mediocrity, and in the end with a threat to the freedom of science and its teaching. This is not to say that I am opposed to government funds being set aside for fundamental research. This is a need of our time, a necessity. But precautions should be taken and a watchful eye should be kept to prevent such funds from working to the detriment of real science. It is the young generation, who will profit from the incoming funds, who should also be alerted against the danger that politicians, both those within and those outside the universities, will take over science. The young researcher must insist upon the right to think for himself, to plan for himself, to make his own mistakes, and to be happy over an unplanned, unforseen discovery. Real progress in science has always been made and will always be made by the free mind, left to its own working under a system where science is free."

TEACHING INSTITUTIONS AND RESEARCH

In *The Times* of February 17th, Professor C. H. Browning, of the Department of Bacteriology, University of Glasgow, raises an interesting issue. He writes: "Your Special Correspondent in his article of February 9th on 'The Tsetse Fly' has drawn attention to new drugs with powerful curative action on cattle disease due to *Trypanosoma congolense* which have been produced in this country—phenanthridinium 1553 (dimidium bromide) and more recently antrycide. It is of interest to contrast the circumstances attending these two discoveries. Antrycide, we learn, was the outcome of the combined efforts of a considerable band of chemists and biologists in the Research Laboratories of Imperial Chemical Industries, Ltd., headed by the late Dr. F. H. S. Curd and Dr. D. G. Davey, and backed by the large resources available to such an institution. Dimidium bromide arose from a small-scale co-operation between two chemists in London and several biologists in Glasgow. This substance was developed by Dr. L. P. Walls in the Chemical Research Laboratory of the Department of Scientific and Industrial Research, Teddington, as one of a series of compounds synthesised by the late Sir Gilbert Morgan and himself. Its curative effect on animals infected with *Trypanosoma congolense* was first demonstrated and explored in my department, the work being supported by the Medical Research Council. In the case of both drugs the joint efforts of two highly specialised departments of research—namely, chemistry and biology—were essential in order to realise the results which justified field trials.

"It will be recalled that the sulphonamide drugs and penicillin also demanded similar co-operation for their fruition. These instances exemplify two points of great practical importance. The first is that the results can be achieved only by the organised collaboration of workers drawn from different fields of scientific activity. While great advances have been made, there is no doubt that for future progress in chemotherapy the additional help of bio-chemists, physical chemists and others will be essential. Indeed it is incontestable that the discovery of new chemotherapeutic agents is impossible except on such lines. Secondly, the recruitment and integration of the considerable forces required for these researches is at present scarcely contemplated by universities, but in view especially of the stimulating effect of those in course of training it would be a great misfortune for the progress of science if work in this field were to pass wholly to the laboratories of industrial corporations and special research institutes unconnected with teaching functions."

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USE OF THE TERM "COLIFORM"

"The term 'coliform' has for some time had an obscure meaning, and it has become increasingly clear that a definition is desirable," states *Nature* in its issue of March 12th, and proceeds: "Those interested in medical and veterinary bacteriology have used it to embrace only the morphological characters of many species, not of *Bacterium coli* alone, but also of the dysentery bacteria, the salmonella and other Gram-negative rods similar to *Bacterium coli*. On the other hand, the term 'coliform' is restricted by many water and dairy bacteriologists to those organisms which are not only morphologically similar to *Bacterium coli* but which also resemble it in its cultural and biochemical characteristics; some have even regarded it as being synonymous with *Bacterium coli* of faecal origin. Because of this confusion and also because there is now a closer liaison between all those who study bacteria from whatever aspect, a committee of nine representing this variety of interests was appointed by the Society for General Microbiology and by the Society for Applied Bacteriology. This committee met on several occasions to discuss various aspects of the matter, and it is hoped that bacteriologists in general will be able to agree upon the meaning of the term 'coliform' which has been put forward.

"Dr. Reginald Lovell (for the Society for General Microbiology), Royal Veterinary College, London, N.W.1, and Dr. C. B. Taylor (for the Society for Applied Bacteriology), c/o Messrs. Lever Brothers and Unilever, Ltd., Port Sunlight, Cheshire, have forwarded the following relevant portions of the committee's report: '(1) The term "coliform" means "like *Bacterium coli*", or "coli-like". (2) "Coliform" is an adjective, and as such has no generic or ecological significance. (3) It is proposed that the term "coliform" should refer to Gram-negative rods resembling *Bacterium coli* in morphology and staining reactions, but not necessarily in cultural and biochemical characteristics. (4) That the widest publicity should be given to this definition to prevent the term being employed to define different specific types by different workers, or to restrict the term to particular branches of bacteriology. The committee is convinced that the proposed definition is the only one satisfactory to all interests in bacteriology and is opposed to any definition based on ecology or biochemical reactions. Existing systems allow for classification of organisms grouped under the wide term now proposed.'"

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A DAY IN THE LIFE OF A KENYA VETERINARIAN

A correspondent from Kenya sends us the following contribution appearing in his local paper, "as it is possible that if the variety of interesting work to be found in the Colonies were brought to the notice of the profession, it might assist the more intrepid young men in making up their minds to choose the Colonial Veterinary Service."

Take a look at any veterinary area in Kenya to-day, talk to any V.S. of your acquaintance, check up the area he has to cover and go into his working day during the dry weather *and* the rains. The result will give most settlers and I include particularly Residential Settlers with their horses, dogs, cats and pets generally a nasty jerk. Residential Settlers have no conception of what a farm visit means to inspect perhaps 200 head of cattle.

The position was nearing the limit before the war, but now in each area there are the hundreds of new settlers, most of them with animals of sorts, which entails many score of extra visits for the V.O. of the area.

Being interested in the subject I found out from several of my veterinary friends what an average day entailed—here is one sample:—

6.30 a.m. called.

7.15 a.m. to office.

7.30 a.m.—Visited farm 35 miles away to examine 40 cows for sterility and test a bull. "Being on the spot" was asked if he would take the opportunity of cutting a colt.

On the way back in at another farm to start the tuberculin test on an imported bull. "Being on the spot" was asked to ring a couple of bulls as the farmer was new to farming and didn't know how! Then unfortunately something had gone wrong with one of the horses and could he spare a few minutes to examine it?

1.15 p.m. got back to lunch.

1.45 p.m.—Car drew up outside the house. (Groans from within the house) a lady with a sick cat implored his help. She was so sorry for calling, but her cat meant so much to her and the poor thing was so ill. She knew the only chance of getting help was to come during the lunch hour.

2 p.m.—Decided to spend two hours in the office to catch up with arrears of correspondence and paper work generally.

2.15 p.m.—Settlers arrived with a chicken that had developed some tiresome disease and the owner was terrified it would run through his whole flock. (Trouble caused by failing to observe normal inoculation.)

2.30 p.m.—Chicken owner departed.

2.31 p.m.—Settler arrived with valuable dog who was very sick. Apologised profusely for disturbing V.O. but would he help?

2.50 p.m.—Dog owner gratefully departed.

2.55 p.m.—Carcase of stillborn calf brought in: would V.O. please examine and give reply to boy in case it might be something serious requiring segregation of the cow.

3.15 p.m.—Tried to start first letter—rather an urgent one.

3.20 p.m.—Settler arrived with a parrot which was badly off colour. Could V.O. say what was wrong and how to cure it? It was the only pet and companion of an elderly person.

3.30 p.m.—Telegram from a D.C. in a native Reserve 130 miles away saying his horse was very sick and could V.O. make his monthly visit earlier than usual. (Note: Impossible to fit in before another week).

3.45 p.m.—Wire from a settler asking for a reply to a letter written six days previously. Couldn't understand why he had not received a reply!

4 p.m.—To slaughterhouse to inspect meat.

4.30 p.m.—To farm 22 miles away to examine bulls overdue for insurance. "Being on the spot" would V.O. mind examining a few cows to see if they were in calf. On the way back stopped at two more farms, at the first to examine a sick horse and at the second to open up an abscess on a cow. This latter had to be done by the headlights of the car.

8 p.m.—Completely worn out got home to find (*a*) a stinking bit of dead cow, the owner suspecting a serious disease, which it wasn't; (*b*) a long telegram from the head office concerning a sticky problem about a stock route.

And so to a bite of dinner and bed.

Every day new settlers are arriving and they soon acquire animals. Being fond of their beasts, be they cattle, sheep, horses, dogs, poultry or pet birds, they try and get attention for them when sick. The V.O. being a good fellow and human, does what he can.

Many people regard a couple of hundred miles motoring as a day's job in itself. For our V.O.'s such distances are incidental to a

very arduous and technical day's work. I have literally seen a V.O. fall asleep in the middle of a conversation.

The pace demanded is too high. If we want the country to develop properly we must see that more V.O.'s and veterinary surgeons are available in these enormous areas on a scale to make the day's work reasonable.

I have seen the way several of our V.O.'s plan their work ahead. They have lists of farms all over the area requiring cattle inspection "in due course." Then comes a very urgent request for a valuable beast to be examined or treated. These urgent cases are made to fit in with several of the "in due course" requests.

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MINISTRY OF AGRICULTURE NEWS SERVICE

Some Present-day Problems in Sheep Husbandry

There can be no question of the need to expand our sheep population. In the first place it is obvious that we must produce more meat in this country, and sheep as a class of stock can add to our home produced meat supplies without the need for consuming any material quantity of concentrated foodstuffs. By some it is argued that the expansion of our sheep population should be confined to the hill land of Great Britain, and while it is certainly desirable that the numbers of hill sheep should be increased, there is no doubt at all about the present-day need for getting back more sheep on to our mixed farms, particularly those in upland areas where light textured soils are "sound" for sheep.

Secondly, it is obvious to anyone who travels through mixed farming areas that there is much waste of potential food for sheep. At the present time we hear of market garden crops being ploughed in because of glutted markets. Some of these crops could be converted into mutton if adequate supplies of store sheep were available. Again, on farms which produce a large acreage of cereal crops, several months of stubble grazing can be obtained. We have increased our acreages of temporary ley, yet in many counties there has not been an increase in livestock population to balance the increased productivity of the ley swards.

One last argument to support the plea for more sheep is this. To maintain the light texture soils in a state of high productivity, systems of farming in which livestock production was integrated with crop production maintained satisfactory yields and disease free crops. Just over 100 years ago Cobbett recorded his impressions of a journey through Wiltshire and he pointed out that in some parishes very large sheep stocks were maintained and a considerable acreage of the arable land was sown to wheat. In the chalk counties of Southern England it is now apparent that the fertility level of much land is such that wheat yields are relatively low, though good yields of barley can be grown. While it is freely admitted that we cannot go back to the old economy in which vast quantities of oil cakes were fed to sheep folded on arable crops, we can still use sheep as soil texture improvers by grazing them on cheaply grown cruciferous crops such as rape.

Unfortunately, to-day many farmers are reluctant to add a sheep enterprise to their present farming system. They argue that there is a lack of skilled shepherding labour and some argue that sheep are problem creatures from the husbandry point of view, because they die so easily. So long as the defeatist attitude of mind persists, sheep will not return to many of the mixed farms which should now be carrying flocks. We must bear in mind, however, that in sheep farming there is only one kind of bad luck, that is loss due to inclement weather, and this loss we can do little to control, although we may reduce it. But so far as ordinary causes of loss are concerned good husbandry is all that is needed. By this is meant the use of dip preparations containing DDT, for these have proved their value in controlling blow-fly strike; the control of internal parasites—again preventing much loss through worm infestations—while mixed stocking, that is in association with cattle, and frequent changes of grazing area, will do much to maintain higher standards of ovine health. Finally, some attention to the provision of a minerally efficient diet to sheep, will do much to ensure their health and high productivity.

Pigs on the Farm.—Purchased feeding-stuffs as we used to know them will be scarce for some years to come, so it will not be possible for specialist pig breeders and feeders to operate on a large scale immediately. But the pig is an accommodating animal that can thrive successfully on a wide variety of foods. Up to a point, therefore, feeding raises no insuperable difficulties to the maintenance and even the increase of the present pig population. And apart from foods such as swill, every farm has considerable quantities of tail corn, small potatoes, roots and so on, which can be used economically in feeding pigs.

Many farms, too, have buildings suitable for pigs which have fallen into disuse but could be adapted with very little difficulty. One or more sties, seldom if ever used in earlier days, or a spare loose box would make useful housing for a few pigs.

Some pigs on every farm rather than many pigs on a few farms is the line we must travel for some time to come. That would mean a substantial increase in the number of pigs kept, without affecting the supply of purchased feeding-stuffs. The time will come again when it will be possible to breed and feed pigs in large numbers. To breed pigs of good quality is as easy as to breed indifferent pigs, and if a sound foundation is to be laid for the future well-being of the industry it is important to select breeding stock of quality.

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LIVESTOCK ON THE ISLES OF SCILLY

Mr. F. W. Sheppera, County Agricultural Officer, Isles of Scilly, in the course of a contribution to *Agriculture* (March) on that industry in the Isles, observes: "The islands are self-supporting in milk, but it is not possible to send any to the mainland; nor could supplies coming by steamer be relied upon. Milking is done in the fields on some farms in the summer, and many animals are out-of-doors all the time, except for milking. The cattle are almost exclusively Guernsey or Guernsey type, pedigree bulls of that breed having been used for about 25 years on St. Mary's and for nearly as long on Tresco; St. Agnes and St. Martin's usually obtain young bulls from one or other of these islands and, while they are not pedigree animals, they are of good Guernsey type. Farmers on the remaining island of Bryher rely on the neighbouring Tresco, which can be reached through a few inches of water during an hour or so in the middle of a few days each month when spring tides provide low water. There is very little traffic of animals in either direction between the islands and the mainland, and as a result of this isolation the animals here are remarkably free from disease. Contagious abortion has not occurred for many years, mastitis is rare, and as a result of tests carried out in the past 18 months, over 90 per cent. of the herds are now attested and the remaining few are awaiting further tests before getting their certificates.

"In the last year or two efforts have been made to improve the cattle still further, with a view to building up a stock from which heifers and young bulls can be sold on the mainland. A Milk Recording Society was formed at the beginning of 1948, and with its aid it is hoped that some herds may grade up to pedigree standard, that many more will produce young stock with good records behind them, and that the progeny of the bulls in use will provide information as to their value. It is realised that cattle are essential both to supply milk and to make use of the grass which can form an integral part of the farm rotations. Since the Guernsey is well suited to the mild but windy climate and to the lime-deficient soil, there is every encouragement to improve and provide much needed replacement stock for less-favoured areas.

"Other animals are of much less importance than the cattle. It is extremely difficult to produce corn to help feed pigs or poultry, and if it were grown it could not be threshed. No sheep have been kept for some years; the breeds which would suit the rough, open country would be difficult to keep out of the important arable fields, and the small farms could not find much keep for other kinds. Horses are still the main source of power for hauling seaweed and for the land work, but all these are brought from the mainland and no stallion is kept."

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CONSOLIDATION OF THE POISONS RULES

The Poisons Rules, 1949 (H.M.S.O., price 9d.) which were laid before Parliament on March 25th, came into operation on April 11th. This revision of the Poisons Rules (Statutory Instruments, 1949, No. 539) replaces the rules of 1935 made under Section 23 of the Pharmacy and Poisons Act, 1933, and all the Amendments to those rules which have been issued from time to time. The Poisons List is also brought up to date through the medium of the Poisons List Order, 1949.

The Fourth Schedule again lists those substances required to be sold by retail "only upon a prescription given by a duly qualified medical practitioner, registered dentist, registered veterinary surgeon, or registered veterinary practitioner." Such substances will continue to be governed by the rule which lays down that a prescription shall:

(*a*) be in writing and be signed by the person giving it with his usual signature and be dated by him;

(*b*) except in the case of a health prescription, specify the address of the person giving it;

(*c*) specify the name and address of the person for whose treatment it is given or, if the prescription is given by a veterinary surgeon or practitioner, of the person to whom the medicine is to be delivered;

(*d*) have written thereon, if given by a dentist, the words "For dental treatment only" or, if given by a veterinary surgeon or practitioner, the words "For animal treatment only";

(*e*) indicate the total amount of the medicine to be supplied

and, except in the case of a preparation which is to be used for external treatment only, the dose to be taken.

A prescription which comes under the Fourth Schedule must not be dispensed more than once unless the prescription directs that it may be dispensed a stated number of times or at stated intervals; there must be noted the name and address of the seller and the date on which the prescription was dispensed. The prescription must also be retained and kept on the premises for two years so that it is readily available for inspection.

In the Third Schedule of the Poisons Rules there are listed the articles exempted from the provisions of the Pharmacy and Poisons Act and of the Rules. The other schedules follow the pattern laid down in the twelve schedules of the 1935 Poisons Rules. An additional four schedules are concerned with such matters as the purchase of strychnine for killing seals and the colouring of some compounds of arsenic.

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LONDON VAN HORSE PARADE

For the 35th parade of van horses held in glorious weather in Regent's Park on Easter Monday there was an entry of 317 singles, 14 pairs and two teams, *viz.*, 353 horses as compared with 333 animals last year. This was deemed to be very satisfactory considering the difficulties with which owners and drivers still have to contend in keeping their horses, harness and vehicles up to the high standard required.

The parade was instituted in 1904, on the suggestion of the late Lord Woolavington, and that it remains one of the most popular Easter Monday attractions in Town was again evidenced by the great throng of interested and enthusiastic spectators as the procession moved along the "inner circle" past the point at which prizes were presented by Frances, Lady Daresbury, president of the London Van Horse Parade Society and Major H. Faudel-Phillips (chairman).

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CORRESPONDENCE

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the N.V.M.A.

UNIVERSITY QUALIFYING DEGREES

Sir,—I read with some interest the letter by Mr. T. M. Leach on University Qualifying degrees in the *Record* of February 12th. I agree with him most heartily when he suggests that a Bachelor degree in Veterinary Science should be considered an ancillary or additional qualification and not the licence to practise.

However, I disagree with his contention that a B.V.M. or V.M.B. would be distinctive or adequate. He suggests that the Universities might not grant a Doctorate as a primary qualification. This may be true, but the question should not have to rise since the veterinary students would be well able if necessary to satisfy the requirements for a B.Sc. or B.A. prior to or during the course of advanced veterinary study.

Apart from this point, the Ph.D. can be obtained at many Universities, I believe, in six years or even less time subsequent to matriculation. This would approximate to the time necessary to obtain a Doctorate in Veterinary Medicine, and no one would suggest that the quality of the work for the latter degree would be in any way inferior.

Yours faithfully,

Auburn, Alabama. *March 17th*, 1949.

F. H. Manley, Professor, Department of Bacteriology and Pathology, School of Veterinary Medicine.

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NIGHT VETERINARY SERVICES

Sir,—The singular unanimity of opinion amongst metropolitan veterinary surgeons regarding night veterinary services must give Major Hancock food for thought.

The pertinent questions and suggestions put forward by your correspondents demand equally constructive answers from the animal welfare societies, to whose special attention I would commend paragraph iv of Mr. Knight's communication in your issue of April 9th.

Yours faithfully,

43, The Mall, Ealing, W.5. *April 10th*, 1949.

R. L. Steele.

Sir,—Mr. Knight's contribution to this correspondence prompts me to say that the question of unnecessary night and week-end calls arises probably quite as frequently in large-animal practice in agricultural areas as in small-animal practice in the Metropolitan area.

There is, for example, the ever-recurring case on the evening of market day when the stock owner returns home late at night to find that one of his animals has been very ill all day and he has neglected to delegate to those left at home the responsibility of seeking professional assistance.

The recommendations 1a and b in the report Mr. Knight adds to his letter are just as applicable to large- as to small-animal practice.

During the war, propaganda on these lines on the grounds of saving petrol, was in my experience, quite successful. I suggest that such propaganda could usefully be renewed to-day to relieve practising members of the veterinary profession of a good deal of unnecessary nervous and physical strain.

Yours faithfully,

Orchard House, Priestpopple, Hexham, Northumberland. *April 10th*, 1949.

J. P. Pickering.

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COMMEMORATION OF THE DISCOVERY OF TOXOIDS

Sir,—I beg to express many thanks for the announcement of the commemoration of the discovery of "antitoxins" in the March 26th number of *The Veterinary Record*, but I wish to question the translation in English of the French word "anatoxines."

The proper translation, in my opinion, is "toxoïds," whereas antitoxins refer to different substances of which Professor Ramon was not the originator.

"Toxoïds" (or, in French, anatoxines) are the substances involved in the commemoration of Ramon's work and their importance is sufficient to explain the rightful pride of the veterinary profession that one of its members was at the very beginning of their discovery.

Yours faithfully,

H. Pean, *Secrétaire Général*, Comité National pour la Commemoration du 25ème Anniversaire dela Decouverte des Anatoxines.

DISEASES OF ANIMALS ACTS, 1894 TO 1937, AND AGRICULTURE ACT, 1937 (PART IV).

Summary of Returns of Confirmed Outbreaks of Scheduled (Notifiable) Diseases

Period	Anthrax	Foot-and-mouth	Fowl Pest	Parasitic Mange*	Sheep Scab	Swine Fever
Mar. 16th to 31st, 1949	7	3	22	—	5	—
Corresponding period in—						
1948	4	—	20	—	3	—
1947	1	6	25	—	1	4
1946	3	2	—	—	1	38
Jan. 1st to Mar. 31st, 1949	41	9	123	—	26	4
Corresponding period in—						
1948	29	—	149	1	21	7
1947	16	83	27	1	14	14
1946	29	20	—	4	34	171

NOTE.—The figures for the current year are approximate only.
* Excluding outbreaks in Army Horses.

Tuberculosis (Attested Herds) Schemes

The number of Attested Herds, *i.e.*, herds officially certified as free from Tuberculosis as at March 31st, 1949, was as follows:—

England	Wales	Scotland	Total (Great Britain)
14,586	12,827	11,323	38,736